WHAT IS CLAIMED IS:

1. An apparatus for alerting a pilot of a rotary wing aircraft of proximity to terrain, the apparatus comprising:

an input for receiving signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft, and coupled to a database of stored terrain information;

an output;

a signal processing device, coupled to said input, and coupled to said output, for:

(a) defining a look ahead distance;

(b) defining a first alert envelope, indicative of a first severity of terrain threat, wherein boundaries of said first alert envelope are determined as a first function of the flight path angle, said look ahead distance, and a terrain floor boundary; wherein said terrain floor boundary comprises a function of an aircraft altitude and said speed;

(c) defining a second alert envelope, indicative of a second severity of terrain threat, wherein boundaries of said second alert envelope are determined as a second function of the flight path angle, said look ahead distance and said terrain floor boundary; and

(d) outputting an alert signal when a subset of the stored terrain information is located within the boundaries of at least one of said first and said second alert envelopes.

2. The apparatus of claim 1 wherein at least one of said first and second alert envelopes is further bounded by a cut-off envelope.

3. The apparatus of claim 1 wherein said signals representative of the position of an aircraft include a first signal received from a satellite navigation system indicative of the aircraft altitude and a second signal representative of the aircraft altitude received from a source other than the satellite navigation system, and wherein said signal processing device further comprises a means for determining a compound altitude signal.

4. The apparatus of claim 1 wherein the boundaries of at least one of said first and second alert envelopes is further determined as a function of a configurable datum.

5. The apparatus of claim 1 wherein at least one of said first and second alert envelopes further comprises a subset of alert envelopes representing various severities of hazard to the aircraft.

6. The apparatus of claim 1 wherein said signal processing device comprises a microprocessor.

7. The apparatus of claim 1 wherein said signal processing device comprises a means for outputting said alert signal as a video control signal, wherein said video control signal is useful for controlling representation of terrain on a video display in various colors according to a degree of terrain threat.

8. The apparatus of claim 1 further comprising a voice warning generator coupled to said signal processor and wherein said alert signal output from said signal processing device comprises an audio control signal to command said voice warning generator to output an aural alert.

9. The apparatus of claim 1 wherein said speed comprises a groundspeed of the aircraft.

10. The apparatus of claim 1 wherein the aircraft is a tilt rotor.

11. The apparatus of claim 1 wherein said signal processing device further comprises a means for outputting a video control signal to control representation of a background terrain data proximate the aircraft:

in a first color for terrain located more than a predetermined amount relative to a current altitude of the aircraft wherein said predetermined amount is a first value for a cruise phase of flight and a second value for an approach phase of flight and a third value for a landing phase of flight; and

in a second color for terrain located less than said predetermined amount relative to said current altitude.

12. The apparatus of claim 11 wherein said cruise, approach and landing phases are defined as a function of said speed of the aircraft.

13. The apparatus of claim 1 wherein said look ahead distance is a function of a distance to transition from a first phase of flight to a hover phase of flight.

14. A method for alerting a pilot of a rotary wing aircraft of proximity to terrain comprising the steps of:

accessing a database of terrain information;

receiving signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft;

defining a look ahead distance;

defining a first alert envelope, indicative of a first severity of terrain threat, wherein boundaries of said first alert envelope are determined as a first function of the flight path angle, said look ahead distance, and a terrain floor boundary;

defining a second alert envelope, indicative of a second severity of terrain threat, wherein boundaries of said second alert envelope are determined as a second function of the flight path angle, said look ahead distance and said terrain floor boundary;

defining said terrain floor boundary as a function of an aircraft altitude and said speed; and

outputting an alert signal when a subset of the stored terrain information is located within the boundaries of at least one of said first and said second alert envelopes.

15. The method of claim 14 wherein said step of outputting an alert signal further comprises the step of outputting a video control signal to control display of terrain on a display device.

16. The method of claim 14 further comprising the step of defining a cut-off envelope to form a boundary of at least one of said first and second alert envelopes.

17. The method of claim 14 further comprising the step of receiving a first and a second altitude signal from a distinct first and second sources respectively to obtain a compound altitude signal representative of the aircraft altitude.

18. The method of claim 14 wherein said step of outputting an alert signal comprises outputting an audio control signal to generate an aural alert.

19. The method of claim 14 further comprising the step of outputting a video control signal to control representation of terrain in a first color for terrain located more than a predefined amount relative to current altitude of the aircraft and in a second color for terrain located less than said predefined amount relative to said current altitude wherein said predefined amount is a first value for a cruise phase of flight, a second value for an approach phase of flight, and a third value for a landing phase of flight.

20. A computer program product for alerting a pilot of a rotary wing aircraft of proximity to terrain comprising:

a computer readable storage medium having computer readable program code means embodied in said medium, said computer readable program code means comprising:

a first computer instruction means for accessing a database of terrain information;

a second computer instruction means for accessing signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft;

a third computer instruction means for defining a look ahead distance;

a fourth computer instruction means for defining a first alert envelope, indicative of a first severity of terrain threat, wherein boundaries of said first alert envelope are determined as a first function of the flight path angle, said look ahead distance, and a terrain floor boundary;

a fifth computer instruction means for defining a second alert envelope, indicative of a second severity of terrain threat, wherein boundaries of said second alert envelope are determined as a second function of the flight path angle, said look ahead distance and said terrain floor boundary;

a sixth computer instruction means for defining said terrain floor boundary as a function of an aircraft altitude and a said speed; and

a seventh computer instruction means for outputting an alert signal when a subset of the stored terrain information is located within the boundaries of at least one of said first and said second alert envelopes.

21. The computer program product of claim 20 further comprising an eighth computer instruction means for outputting a video control signal to control display of terrain on a display device.

22. The computer program product of claim 20 further comprising an eighth computer instruction means for defining a cut-off envelope to form a boundary of at least one of said first and second alert envelopes.

23. The computer program product of claim 20 further comprising an eighth computer instruction means for accessing a first and a second altitude signal from a distinct first and second sources respectively to obtain a compound altitude signal representative of the aircraft altitude.

24. The computer program product of claim 20 wherein said seventh computer instruction means further comprises a means for outputting an audio control signal to generate an aural alert.

25. The computer program product of claim 20 further comprising an eighth computer instruction means for outputting a video control signal to control representation of terrain in a first color for terrain located more than a predefined amount relative to a current altitude of the aircraft and in a second color for terrain located less than said predefined amount relative to said current altitude wherein said predefined amount is a first value for a cruise phase of flight, a second value for an approach phase of flight, and a third value for a landing phase of flight.

26. An apparatus for alerting a pilot of a hover-capable aircraft of proximity to terrain, the apparatus comprising:

an input for receiving signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft, and coupled to a database of stored terrain information;

an output;

a signal processing device, coupled to said input, and coupled to said output, for:

(a) defining a look ahead distance as a function of a distance to transition from a first phase of flight to a hover phase of flight;

(b) defining a first alert envelope, indicative of a first severity of terrain threat, wherein boundaries of said first alert envelope are determined as a first function of the flight path angle, said look ahead distance, and a terrain floor boundary;

(c) defining a second alert envelope, indicative of a second severity of terrain threat, wherein boundaries of said second alert envelope are determined as a second function of the flight path angle, said look ahead distance and said terrain floor boundary; and

(d) outputting an alert signal when a subset of the stored terrain information is located within the boundaries of at least one of said first and said second alert envelopes.

27. The apparatus of claim 26 wherein at least one of said first and second alert envelopes is further bounded by a cut-off envelope.

28. The apparatus of claim 26 wherein said signals representative of the position of an aircraft include a first signal received from a satellite navigation system indicative of an aircraft altitude and a second signal representative of the aircraft altitude received from a source other than the satellite navigation system, and wherein said signal processing device further comprises a means for determining a compound altitude signal.

29. The apparatus of claim 26 wherein the boundaries of at least one of said first and second alert envelopes is further determined as a function of a configurable datum.

30. The apparatus of claim 26 wherein at least one of said first and second alert envelopes further comprises a subset of alert envelopes representing various severities of hazard to the aircraft.

31. The apparatus of claim 26 wherein said signal processing device comprises a microprocessor.

32. The apparatus of claim 26 wherein said signal processing device comprises a means for outputting said alert signal as a video control signal, wherein said video control signal is useful for controlling representation of terrain on a video display in various colors according to a degree of terrain threat.

33. The apparatus of claim 26 further comprising a voice warning generator coupled to said signal processor and wherein said alert signal output from said

signal processing device comprises an audio control signal to command said voice warning generator to output an aural alert.

34. The apparatus of claim 26 wherein said speed comprises a groundspeed of the aircraft.

35. The apparatus of claim 26 wherein the aircraft is an airship.

36. The apparatus of claim 26 wherein the aircraft is a tilt rotor.

37. The apparatus of claim 26 wherein said signal processing device further comprises a means for outputting a video control signal to control representation of a background terrain data proximate the aircraft:

in a first color for terrain located more than a predetermined amount relative to a current altitude of the aircraft wherein said predetermined amount is a first value for a cruise phase of flight and a second value for an approach phase of flight and a third value for a landing phase of flight; and

in a second color for terrain located less than said predetermined amount relative to said current altitude.

38. The apparatus of claim 26 wherein said cruise, approach and landing phases are defined as a function of said speed of the aircraft.

39. A method for alerting a pilot of a hover-capable aircraft of proximity to terrain comprising the steps of:

accessing a database of terrain information;

receiving signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft;

defining a look ahead distance as a function of a distance to transition from a first phase of flight to a hover phase of flight;

defining a first alert envelope, indicative of a first severity of terrain threat, wherein boundaries of said first alert envelope are determined as a first function of the flight path angle, said look ahead distance, and a terrain floor boundary;

defining a second alert envelope, indicative of a second severity of terrain threat, wherein boundaries of said second alert envelope are determined as a second function of the flight path angle, said look ahead distance and said terrain floor boundary; and

outputting an alert signal when a subset of the stored terrain information is located within the boundaries of at least one of said first and said second alert envelopes.

40. The method of claim 39 wherein said step of outputting an alert signal further comprises the step of outputting a video control signal to control display of terrain on a display device.

41. The method of claim 39 further comprising the step of defining a cut-off envelope to form a boundary of at least one of said first and second alert envelopes.

42. The method of claim 39 further comprising the step of receiving a first and a second altitude signal from a distinct first and second sources respectively to obtain a compound altitude signal representative of the aircraft altitude.

43. The method of claim 39 wherein said step of outputting an alert signal comprises outputting an audio control signal to generate an aural alert.

44. The method of claim 39 further comprising the step of outputting a video control signal to control representation of terrain in a first color for terrain located more than a predefined amount relative to a current altitude of the aircraft and in a second color for terrain located less than said predefined amount relative to said current altitude wherein said predefined amount is a first value for a cruise phase of flight, a second value for an approach phase of flight, and a third value for a landing phase of flight.

45. A computer program product for alerting a pilot of a hover-capable aircraft of proximity to terrain comprising:

a computer readable storage medium having computer readable program code means embodied in said medium, said computer readable program code means comprising:

a first computer instruction means for accessing a database of terrain information;

a second computer instruction means for accessing signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft;

a third computer instruction means for defining a look ahead distance as a function of a distance to transition from a first phase of flight to a hover phase of flight;

a fourth computer instruction means for defining a first alert envelope, indicative of a first severity of terrain threat, wherein boundaries of said first alert envelope

are determined as a first function of the flight path angle, said look ahead distance, and a terrain floor boundary;

a fifth computer instruction means for defining a second alert envelope, indicative of a second severity of terrain threat, wherein boundaries of said second alert envelope are determined as a second function of the flight path angle, said look ahead distance and said terrain floor boundary; and

a sixth computer instruction means for outputting an alert signal when a subset of the stored terrain information is located within the boundaries of at least one of said first and said second alert envelopes.

46. The computer program product of claim 45 further comprising a seventh computer instruction means for outputting a video control signal to control display of terrain on a display device.

47. The computer program product of claim 45 further comprising a seventh computer instruction means for defining a cut-off envelope to form a boundary of at least one of said first and second alert envelopes.

48. The computer program product of claim 45 further comprising a seventh computer instruction means for accessing a first and a second altitude signal from a distinct first and second sources respectively to obtain a compound altitude signal representative of the aircraft altitude.

49. The computer program product of claim 45 wherein said sixth computer instruction means further comprises a means for outputting an audio control signal to generate an aural alert.

50. The computer program product of claim 45 further comprising a seventh computer instruction means for outputting a video control signal to control representation of terrain in a first color for terrain located more than a predefined amount relative to a current altitude of the aircraft and in a second color for terrain located less than said predefined amount relative to said current altitude wherein said predefined amount is a first value for a cruise phase of flight, a second value for an approach phase of flight, and a third value for a landing phase of flight.

51. An apparatus for alerting a pilot of a rotary wing aircraft of proximity to terrain comprising:

an input for receiving signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft, and coupled to a database of stored terrain information;

an output; and

a signal processor, coupled to said input and to said output for:

(a) defining a look ahead/look down alert envelope, wherein boundaries of said alert envelope are determined as a function of the flight path angle, a look ahead distance, and a terrain floor boundary; wherein said terrain floor boundary comprises a function of an aircraft altitude and said speed, and wherein said look ahead distance comprises a function of a distance to transition from a first phase of flight to a hover phase of flight; and

(b) outputting an alert signal when a subset of the stored terrain information is located within the boundaries of said alert envelope.

52. The apparatus of claim 51 wherein said look ahead/look down alert envelope further comprises a first, caution, envelope and a second, warning, envelope.

53. The apparatus of claim 52 wherein said signal processor outputs a first alert signal when said subset of the stored terrain information is located within the boundaries of said caution envelope and a second alert signal when said subset of the stored terrain information is located within the boundaries of said warning envelope.

54. The apparatus of claim 51 wherein said signal processor comprises a microprocessor.

55. The apparatus of claim 51 wherein said speed comprises a groundspeed of the aircraft.

56. The apparatus of claim 51 wherein said signal processing device comprises a means for outputting said alert signal as a video control signal, wherein said video control signal is useful for controlling representation of terrain on a video display in various colors according to a degree of terrain threat.

57. The apparatus of claim 51 further comprising a voice warning generator coupled to said signal processor and wherein said alert signal output from said signal processing device comprises an audio control signal to command said voice warning generator to output an aural alert.

58. The apparatus of claim 51 wherein said signal processing device further comprises a means for outputting a video control signal to control representation of a background terrain data proximate the aircraft:

in a first color for terrain located more than a predetermined amount relative to a current altitude of the aircraft wherein said predetermined amount is a first value for a cruise phase of flight and a second value for an approach phase of flight and a third value for a landing phase of flight; and

in a second color for terrain located less than said predetermined amount relative to said current altitude.

59. The apparatus of claim 58 wherein said cruise, approach and landing phases are defined as a function of said speed of the aircraft.

60. The apparatus of claim 51 wherein said signal processor further defines a look up envelope and outputs said alert signal when said subset of terrain is located within said look up envelope.

61. A method for alerting a pilot of a rotary wing aircraft of proximity to terrain comprising the steps of:

receiving signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft, and stored terrain information;

defining a look ahead/look down alert envelope, wherein boundaries of said alert envelope are determined as a function of the flight path angle, a look ahead distance, and a terrain floor boundary; wherein said terrain floor boundary comprises a function of an aircraft altitude and a said speed, and wherein said look ahead distance comprises a function of a distance to transition from a first phase of flight to a hover phase of flight; and

outputting an alert signal when a subset of the stored terrain information is located within said alert envelope.

62. The method of claim 61 wherein said look ahead/look down alert envelope further comprises a first caution envelope and a second warning envelope.

63. The method of claim 62 further comprising the steps of outputting a first alert signal when said subset of the stored terrain information is located within the boundaries of said caution envelope and outputting a second alert signal when said subset of the stored terrain information is located within the boundaries of said warning envelope.

64. The method of claim 61 further comprising the step of outputting a video control signal, wherein said video control signal is useful for controlling representation of terrain on a video display in various colors according to a degree of terrain threat.

65. The method of claim 61 further comprising the step of outputting an aural alert.

66. The method of claim 61 further comprising the step of outputting a video control signal to control representation on a display of a background terrain data proximate the aircraft:

in a first color for terrain located more than a predetermined amount relative to a current altitude of the aircraft wherein said predetermined amount is a first value for a cruise phase of flight and a second value for an approach phase of flight and a third value for a landing phase of flight; and

in a second color for terrain located less than said predetermined amount relative to said current altitude.

67. The method of claim 66 further comprising the step of defining said cruise, approach and landing phases as a function of said speed of the aircraft.

68. The method of claim 61 further comprising the step of defining a look up envelope and outputting said alert signal when said subset of terrain is located within said look up envelope.

69. A computer program product for alerting a pilot of a rotary wing aircraft of proximity to terrain comprising:

a computer readable storage medium having computer readable program code means embodied in said medium, said computer readable program code means comprising:

a first computer instruction means for accessing signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft, and stored terrain information;

a second computer instruction means for defining a look ahead/look down alert envelope, wherein boundaries of said alert envelope are determined as a function of the flight path angle, a look ahead distance, and a terrain floor boundary; wherein said terrain floor boundary comprises a function of an aircraft altitude and said speed, and wherein said look ahead distance comprises a function of a distance to transition from a first phase of flight to a hover phase of flight; and

a third computer instruction means for outputting an alert signal when a subset of the stored terrain information is located within said alert envelope.

70. The computer program product of claim 69 wherein said second computer instruction means further defines said look ahead/look down alert envelope as comprising a first caution envelope and a second warning envelope.

71. The computer program product of claim 70 further comprising a fourth computer instruction means for outputting a first alert signal when said subset of the stored terrain information is located within the boundaries of said caution envelope and outputting a second alert signal when said subset of the stored terrain information is located within the boundaries of said warning envelope.

72. The computer program product of claim 69 further comprising a fourth computer instruction means for outputting a video control signal, wherein said video control signal is useful for controlling representation of terrain on a video display in various colors according to a degree of terrain threat.

73. The computer program product of claim 69 further comprising a fourth computer instruction means for outputting an aural alert.

74. The computer program product of claim 69 further comprising a fourth computer instruction means for outputting a video control signal to control representation on a display of a background terrain data proximate the aircraft:

in a first color for terrain located more than a predetermined amount relative to a current altitude of the aircraft wherein said predetermined amount is a first value for a

cruise phase of flight and a second value for an approach phase of flight and a third value for a landing phase of flight; and

in a second color for terrain located less than said predetermined amount relative to said current altitude.

75. The computer program product of claim 74 further comprising a fifth computer instruction means for defining said cruise, approach and landing phases as a function of said speed of the aircraft.

76. The computer program product of claim 69 further comprising a fourth computer instruction means for defining a look up envelope and wherein said third computer instruction means outputs said alert signal when said subset of terrain is located within said look up envelope.

77. A ground proximity warning system for rotary wing aircraft comprising:

a warning computer including:

(a) an input for receiving signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft, and coupled to a database of stored terrain information;

(b) an output; and

(c) a signal processor, coupled to said input and to said output for:

(i) defining an alert envelope, wherein boundaries of said alert envelope are determined as a function of the flight path angle, a look ahead distance, and a terrain floor boundary; wherein said terrain floor boundary comprises a function of an aircraft altitude and said speed, and wherein said look ahead distance comprises a function of a distance to transition from a first phase of flight to a hover phase of flight; and

(ii) outputting an alert signal when a subset of the stored terrain information is located within the boundaries of said alert envelope; and

a display, having an display input coupled to said output of said warning computer, for displaying said terrain data proximate the aircraft in various colors according to a degree of terrain threat.

78. The system of claim 77 wherein said warning computer comprises a general purpose processor.

79. The system of claim 77 wherein said speed comprises a groundspeed of the aircraft.

80. The system of claim 77 wherein the aircraft is a tilt rotor.

81. A ground proximity warning system for rotary wing aircraft comprising:

a warning computer including:

(a) an input for receiving signals representative of a position of the aircraft, a flight path angle of the aircraft and a speed of the aircraft, and coupled to a database of stored terrain information;

(b) an output; and

(c) a signal processor, coupled to said input and to said output for:

(i) defining an alert envelope, wherein boundaries of said alert envelope are determined as a function of the flight path angle, a look ahead distance, and a terrain floor boundary; wherein said terrain floor boundary comprises a function of an aircraft altitude and said speed, and wherein said look ahead distance comprises a function of a distance to transition from a first phase of flight to a hover phase of flight; and

(ii) outputting an alert signal when a subset of the stored terrain information is located within the boundaries of said alert envelope; and

a display, having an display input coupled to said output of said warning computer, for:

(a) displaying said terrain data located in the boundaries of said alert envelope in various colors according to a degree of terrain threat; and

(b) displaying terrain data proximate the aircraft:

(i) in a first color for terrain located more than a predetermined amount relative to a current altitude of the aircraft wherein said predetermined amount is a first value for a cruise phase of flight and a second value for an approach phase of flight and a third value for a landing phase of flight; and

(ii) in a second color for terrain located less than said predetermined amount relative to said current altitude.

82. The system of claim 77 wherein the aircraft is a tilt rotor.

83. The method of claim 14 wherein said speed comprises a groundspeed of the aircraft.

84. The computer program product of claim 20 wherein said speed comprises a groundspeed of the aircraft.

85. The method of claim 39 wherein said speed comprises a groundspeed of the aircraft.

86. The computer program product of claim 45 wherein said speed comprises a groundspeed of the aircraft.

87. The method of claim 61 wherein said speed comprises a groundspeed of the aircraft.

88. The computer program product of claim 69 wherein said speed comprises a groundspeed of the aircraft.

89. The method of claim 1 wherein said look ahead distance comprises a function of a distance to a nearest runway.